THE SPECIES OF *COTESIA* CAMERON (HYMENOPTERA: BRACONIDAE: MICROGASTRINAE) PARASITISING LYCAENIDAE (LEPIDOPTERA) IN BRITAIN

MARK R. SHAW

Honorary Research Associate, National Museums of Scotland, Chambers Street, Edinburgh EH1 1JF

ABSTRACT

A key is given to five species of *Cotesia* (*C. astrarches* (Marshall), *C. cuprea* (Lyle), *C. inducta* (Papp), *C. saltatoria* (Balevski) and *C. tenebrosa* (Wesmael)) that parasitise the larvae of Lycaenidae in the British Isles. Two (*C. inducta* and *C. saltatoria*) are newly recorded from Britain and one (*C. astrarches*) is raised from synonymy. Taxonomic notes, host records and distributional data are given for all species. A lectotype is designated for *Apanteles astrarches* Marshall, 1889.

INTRODUCTION

Species of *Cotesia* Cameron (Braconidae: Microgastrinae) are endoparasitoids of Lepidoptera larvae, especially (but not exclusively) those of so-called "macro-lepidoptera". They are koinobionts – that is, the host continues its life for a time after being parasitised – and different species are either solitary or gregarious with respect to their host. Usually oviposition is into an early instar of the host larva, and the fully-fed *Cotesia* larva(e) erupts from a later host instar to spin its sometimes characteristic cocoon(s) externally: often the host does not die immediately after parasitoid eruption, but is left in a voluntarily quiescent state and dies only some days later. These parasitoids are often reared by entomologists who collect caterpillars but *Cotesia* is a large genus and reliable identification sometimes proves troublesome, even though most species have quite narrow host ranges. This paper treats the species that parasitise Lycaenidae in Britain.

Nixon (1974), in his revision of N.W. European species of the part of the traditional genus *Apanteles* that was later (Mason, 1981) recognised as *Cotesia*, included only two species with rearing records from Lycaenidae in Britain, that he called *Apanteles arcticus* Thomson (in error for (Thomson)) and *Apanteles cupreus* Lyle. Subsequently Papp (1986) showed that in mainland Europe two species had gone under the name *A. arcticus*, which he called *A. arcticus* and *A. tenebrosus* (Wesmael), but he did not record the former from Britain. Because Nixon (1974) had included *Apanteles astrarches* Marshall (described from Britain) as a synonym of *A. arcticus*, Papp (1986) was obliged to assign it and he tentatively (but erroneously) placed it as a synonym of *A. tenebrosus*.

Largely through the generosity of many people who have donated reared parasitoids, a considerable quantity of British *Cotesia* reared from various Lycaenidae has been amassed at the National Museums of Scotland, in which five species are present. In addition to the recognition of *C. astrarches* as a valid species distinct from *C. tenebrosa*, two species, *C. inducta* (Papp) and *C. saltatoria* (Balevski), are newly recorded as British. The identity of the true *C. arctica* (Thomson), which might either be a different (non-British) species or a junior synonym, is not addressed.

All of the species treated here are plurivoltine; *C. inducta* overwinters in its cocoon but the other species do so only as (presumably first instar) larva(e) in an

overwintering host larva. Two species, *C. inducta* and *C. saltatoria*, are strictly solitary but the others are gregarious with respect to the host. *Cotesia inducta* is obviously not closely related to the other four species, but even among these four only *C. astrarches* and *C. tenebrosa* seem likely to form a natural group (though formal phylogenetic assessment is lacking).

Females can be identified through the information given below, and in a following section a commentary is given for each species to clarify its nomenclature and host relations.

Unless indicated otherwise, all material is in the National Museums of Scotland (NMS).

Identification

Notes on recognition, characters and terminology

Microgastrinae, to which *Cotesia* belongs, can be separated from other Braconidae through keys given by Shaw & Huddleston (1991) or van Achterberg (1993). General features are their 18-segmented antennae, small or only moderate size, usually rather robust build, and comparatively large hind coxae. As well as through Mason (1981), *Cotesia* can be fairly reliably recognised among Microgastrinae by the combination of a more or less strongly rugose propodeum (=the posterior part of the mesosoma, which is the middle body section) that usually also has a medial longitudinal carina, the first tergite of the metasoma parallel-sided or somewhat widening towards its posterior, at least the apical part of tergite 1 and much of tergite 2 more or less rugose, the ovipositor normally comparatively short and its sheaths extending at most only a little beyond the apex of the hypopygium (and then for a distance not exceeding the length of the hind basitarsus), and venation of the fore wing in which the 2nd submarginal cell (=2nd cubital cell, sometimes also called the areolet) is open – that is, vein 2rs-m in Shaw & Huddleston (1991) =r-m in van Achterberg (1993) is absent (this last is the character that defined the traditional, but polyphyletic, "*Apanteles*" sensu lato). The bodies of most *Cotesia* species are essentially black (a few exceptions occur). As far as parasitoids of British Lycaenidae are concerned, any braconid whose larva (or larvae) comes out of the host larva to spin a silken cocoon (or cocoons) that is not suspended on a thread will probably be a species of *Cotesia*, though there are some campoplegine ichneumonid parasitoids of Lycaenidae that do this, and care should also be taken not to confuse the brown, tanned cuticular puparia of Tachinidae (Diptera) as cocoons.

Antennal segments are numbered from the head so as to include the scape and pedicel; thus the first in the flagellum is the third antennal segment. As all Microgastrinae have 18, segment 15 (which is used in the key for comparative purposes as it is less prone to collapsing or loss through breakage than the more distal segments) is therefore the 4th from the end. The malar space is the shortest distance from the eye to the mandibular socket. The conspicuous anterior tentorial pits are situated near the upper margin of the clypeus laterally and measurements are taken from their middle (deepest part); ratios refer to a facial view. The height of the face plus clypeus is measured perpendicularly from the level of the lower margin of the antennal sockets to the lower margin of the clypeus at its centre. The width of the face is the shortest distance between the eyes. The metasoma is the posterior body part (also known as the gaster), and T1, T2 and T3 refer respectively to its first (anterior), second and third tergites (the SEM illustrations given here have T2 and T3 in plane but often not T1, the length of which is therefore difficult to appreciate).

Although fused, T2 and T3 have a clearly visible suture between them. The hypopygium is the enlarged posterior sternite of the metasoma that is modified to support the ovipositor. The metacarp is the vein of the fore wing that extends along the anterior margin distal to the pterostigma towards the wing apex, and the radial cell is the (poorly defined) cell beneath it.

Cotesia inducta is easily recognised (in both sexes), but the other four species are less easy to separate. All four have the hind femur black and the hind tibia more or less reddish over about its basal half with subequal spurs that only just reach, or fall slightly short of, the mid-length of the basitarsus. The truncate or subacute hypopygium is developed to a comparable degree, and the ovipositor sheaths are rather long and slender, frequently appearing to be cylindrical and projecting well beyond the hypopygium (but this is very variable in death, and in some species a more tapered and dagger-like manifestation is also seen). Useful characters are present in the proportions of the face and eyes, the antennae, the basal (i.e. anterior three) tergites of the metasoma, and wing venation. Unfortunately, however, there is considerable variation in each of these in the long series available; therefore in the key several characters are expressed in each couplet, and majority rather than total agreement should sometimes be expected. Cocoon colour seems to be reliably consistent (although cocoons lose colour both with age and from immersion in alcohol). As is the general situation in *Cotesia*, males (which have much longer antennal segments and hence antennae) show weaker character development and are also more variable than females, and the key given below does not accommodate them at all well.

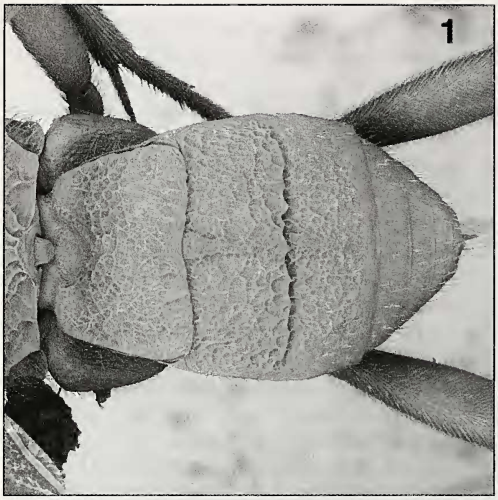
Females of the five British species can be distinguished by the key that follows. Obviously the key cannot be used to identify specimens that have not been reared from Lycaenidae, and it should be noted that further species parasitise Lycaenidae in mainland Europe. Italicised characters in brackets are confirmatory rather than dichotomous. Figs 1–14 were taken on a CamScan MX 2500 scanning electron microscope at 15 kV and spot size 2. Generic placement of butterfly names follows Lafranchis (2004).

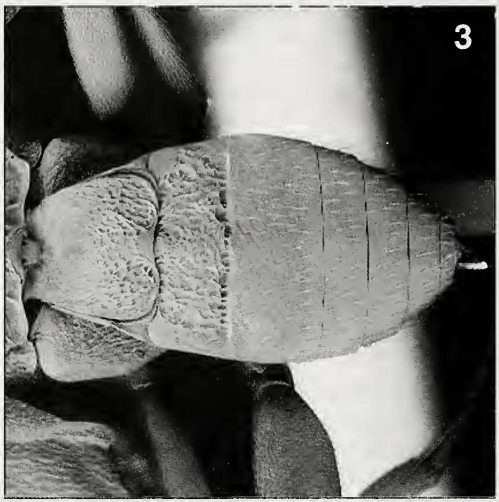
Key to females of species of *Cotesia* parasitising Lycaenidae in Britain

1. T3 not or scarcely longer than T2 and with rugose sculpture over almost all of its surface, almost as intense as on T2 (Fig. 1); hind femur largely orange, infuscate at extreme apex or sometimes (especially in overwintering generation) a little more extensively; hind tibia orange, weakly infuscate in at most apical fifth; underside of scape usually strikingly orange (but often black in overwintering generation); overwintering in cocoon. *(Mesonotum and hind coxa with rather distinct deep punctures. Solitary. Cocoon lemon yellow)* . . . . . ***inducta*** (Papp)

– T3 obviously longer than T2 and largely unsculptured, in any case clearly contrasting with the more or less strong rugose sculpture of T2 (Figs 2–5); hind femur usually entirely black; hind tibia more or less reddish basally, becoming infuscate over at least most of apical half; underside of scape always black; overwintering inside host larva 2

2. Eyes relatively large, usually at least slightly converging (downwards) for almost whole length of face (Fig. 6), and height of eye ca 4.0 times malar space; face ca 1.1 times as wide as height of face plus clypeus (Fig. 6); malar space ca 0.8 times basal width of mandible (Fig. 7); hind tibial spurs a little longer, more or less reaching middle of hind basitarsus; a large species, ca 3 mm; solitary. *(Antenna ca 0.9 times as long as fore wing, its segment 15 usually ca 1.2–1.3 times longer*

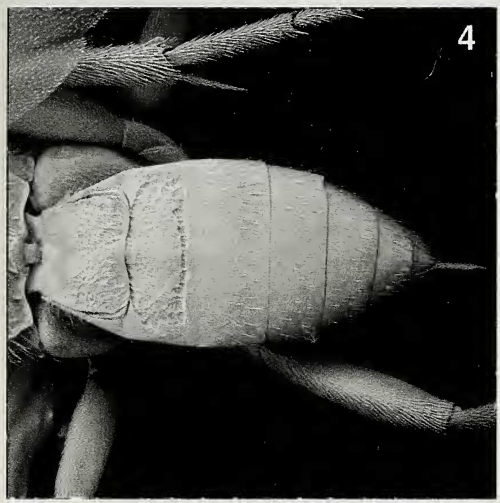


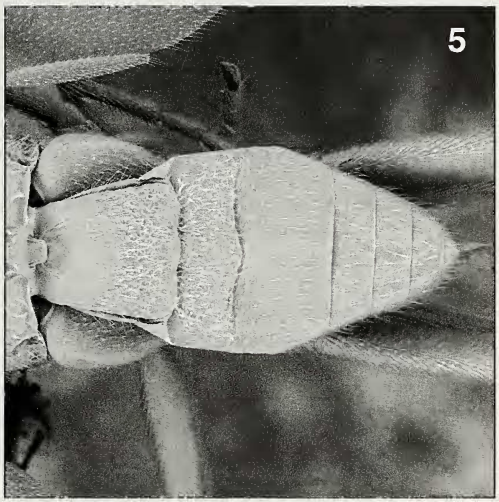


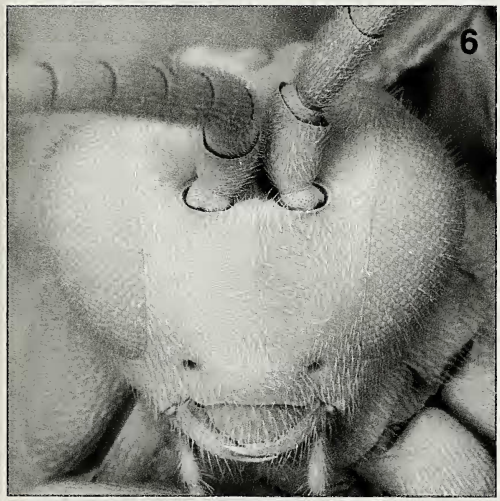
Figs 1–3. *Cotesia* species, metasoma in dorsal view. 1. *Cotesia inducta* (Papp). 2. *Cotesia saltatoria* (Balevski). 3. *Cotesia cuprea* (Lyle).

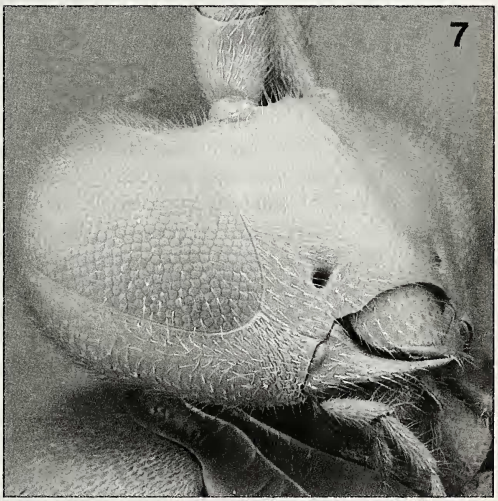
than wide. T1 usually strongly and often rather linearly widening posteriorly; T2 ca 3.3 times wider than long (Fig. 2). Distance between eye and anterior tentorial pit usually ca 0.4 times distance between pits (fig. 6). Metacarp ca 2.2–2.5 times as long as its distance from apex of radial cell. Cocoon bright yellow)
. . . . . ***saltatoria*** (Balevski)

– Eyes smaller, diverging or at most parallel at middle of face and below (Figs 8–11), and height of eye at most ca 3.8 times malar space; face at least 1.2 times as wide as height of face plus clypeus (Figs 8–11); malar space at least as long as basal width of mandible (Figs 12–14); hind spurs shorter, not quite reaching middle of hind basitarsus; smaller species, usually not more than 2.5 mm; gregarious [but broods of 1 could occur] 3









Figs 4–7. *Cotesia* species. 4, 5. Metasoma in dorsal view. 6. Head in facial view. 7. Head in ventro-anterio-lateral view. 4. *Cotesia tenebrosa* (Wesmael). 5. *Cotesia astrarches* (Marshall). 6, 7. *Cotesia saltatoria* (Balevski).

3. Antenna thin, about as long as fore wing, its segment 15 usually 1.5–2.0 times longer than wide; outer side of hind coxa basally dull; malar space about as long as basal width of mandible (Fig. 12); distance between eye and anterior tentorial pit 0.4 or less times distance between the pits (Fig. 8); T2 slightly less transverse, ca 3.0 times wider than long, almost its whole surface often more or less evenly rugose (posteriorly) or at least the anterolateral sulci usually poorly developed (Fig. 3); metacarp ca 2.4–2.7 times its distance from apex of radial cell. *(T1 strongly, sometimes roundly, widened towards apex. Ovipositor sheaths usually appearing slender and cylindrical. Face ca 1.2 times wider than height of face plus clypeus (Fig. 8). T3 sometimes slightly sculptured basally. Cocoons white)* . . . . . ***cuprea*** (Lyle)

– Antenna more robust, about three quarters as long as fore wing, its segment 15 usually 1.0–1.2 times (rarely up to 1.4 times) longer than wide; outer side of hind coxa basally rather shiny; malar space at least ca 1.2 times longer than basal width of mandible (Figs 13,14); distance between eye and anterior tentorial pit at least 0.5 times distance between the pits (Figs 9–11); T2 slightly more transverse, ca 3.2 times wider than long, and usually with fairly distinct anterolateral sulci separating less sculptured margins (Figs 4, 5); metacarp usually less than 2.4 times its distance from apex of radial cell. *(Ovipositor sheaths often appearing to be more tapered, but very variable in death. T3 smooth basally)*. 4

4. Eyes smaller, strongly diverging below, their lower margin well above level of anterior tentorial pits (Figs 9, 10); face ca 1.3 times wider than height of face plus clypeus and ca 1.2 times wider than height of eye (Figs 9, 10); cheeks sometimes appearing very bulging (Fig. 10) and the lower part of the face and clypeus produced centrally; distance between eye and anterior tentorial pits ca 0.7–0.8 times distance between pits (Figs 9, 10); malar space ca 0.5 times height of eye and ca 1.5 times basal width of mandible (Fig. 13); metacarp shorter, ca 1.7–2.0 times its distance from apex of radial cell; T1 very variable but usually more strongly widening posteriorly (Fig. 4, but note that T1 is not in plane), sometimes strongly so; cocoons whitish . . . . . ***tenebrosa*** (Wesmael)

– Eyes larger, less strongly diverging below, their lower margin only a little above level of anterior tentorial pits (Fig. 11); face ca 1.25 times wider than height of face plus clypeus and about as wide as height of eye (Fig. 11); cheeks scarcely bulging (Fig. 11) and the face flatter; distance between eye and anterior tentorial pit ca 0.5–0.6 times distance between pits; malar space ca 0.3 times height of eye and ca 1.25 times basal width of mandible (Fig. 14); metacarp longer, ca 2.0–2.4 times its distance from apex of radial cell; T1 very variable but usually less widened posteriorly (Fig. 5), sometimes hardly widened at all; cocoons distinctly yellow. . . . . ***astrarches*** (Marshall).

Taxonomy, distribution and biology

Cotesia astrarches (Marshall), **stat. rev.**

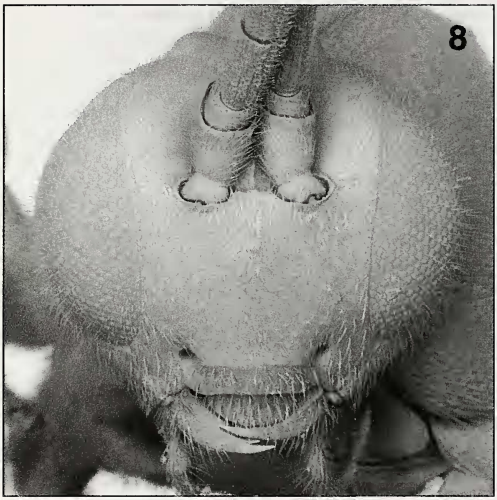
Marshall (1889) described this species from four specimens reared in England from a larva of "*Lycaena astrarche*", now *Aricia agestis* (Denis & Schiffermüller), by [G.C.] Bignell, stating them to be 1 ♀, 3 ♂. Nixon (1974) placed *Apanteles astrarches* Marshall, 1889, in synonymy with *Microgaster (Apanteles) arcticus* Thomson, 1895 (which was described from non-reared material), making no comment other than the

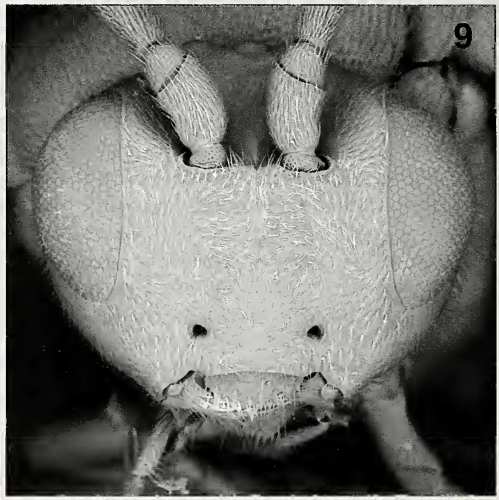
indication "syn. nov." despite his placing the nominal taxon with the earlier name (*astrarches*) as the junior synonym; an anomaly which has been widely followed (e.g. Fitton *et al.*, 1978). Nixon's curious action is possibly explained by his statement that he had seen the type of *arcticus* without his mentioning the type material of *astrarches*, which was in Plymouth museum and which he presumably had not examined. Subsequently Papp (1986), who had previously (Papp, 1973b) seen the type of *arcticus*, separated two species in *A. arcticus* sensu Nixon, that he called *A. arcticus* and *A. tenebrosus* (Wesmael), putting "? *astrarches*" in synonymy with the latter, remarking that [*Cotesia arctica*] (described from Arctic Norway) is a rare species, and (by implication) recording only [*Cotesia tenebrosa*] from Britain.

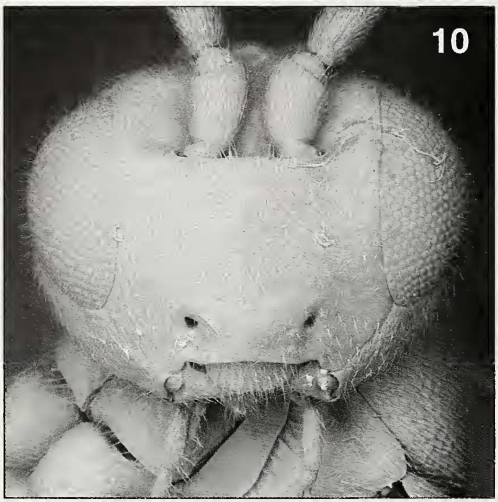
There is considerable material in NMS conforming to [*Cotesia arctica*] sensu Nixon which fairly readily falls into two groups, one corresponding to *C. tenebrosa* (q.v.) and the other, comprising numerous broods (see below) reared from *Aricia agestis* and *A. artaxerxes* (Fabricius), agreeing with the syntype material of *Apanteles astrarches* Marshall, which I have examined (Bignell collection, Plymouth City Museum and Art Gallery). The type series comprises four specimens glued more or less face down to a card, with the labels "3064"; "Type [word inside red circle]"; "Apanteles astrarches Marsh."; and "Ap. Astrarches n. sp. next octonarius". Although the series is of 2 ♀, 2 ♂ rather than the 1 ♀, 3 ♂ stated in the original description, it clearly should be accepted as authentic and I here designate the top left specimen, a female, as the **lectotype** in accordance with my labelling and indication attached to the mount. Incidentally, the recognition of the two closely related species (together comprising *arcticus* sensu Nixon) as *C. tenebrosa* and *C. astrarches* fortuitously somewhat dodges the importance of the identity of the true *C. arctica* in this context as, even if it is conspecific with one or the other (which seems unlikely and it should be noted that it was not described from reared material), *C. arctica* would be a junior synonym in either case.

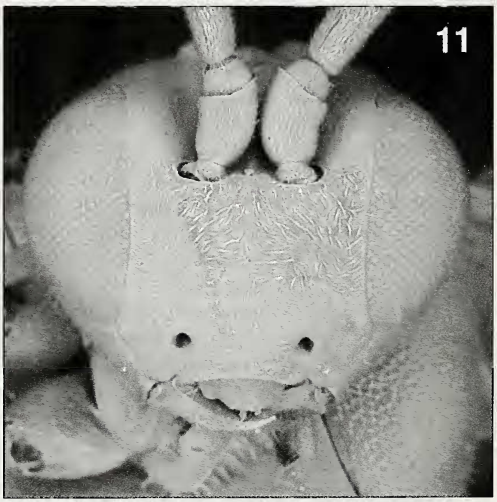
In NMS there are 56 broods of between two and 13 individuals (usually about four to six, but often around 12 – possibly representing additional oviposition visits?) of *C. astrarches* reared from *Aricia agestis* in central E. England and N. Wales (45 broods; VCs 49, 54, 57, 61, 62, 64; *R. Menéndes Martínez, R. Wilson*) collected on all three of its main foodplants *Helianthemum nummularium, Geranium molle* and *Erodium cicutarium*, and from *Aricia artaxerxes* in eastern C. and S. E. Scotland and N. England (11 broods; VCs 65, 66, 69, 81, 82, 90; *P. Summers, M. R. Shaw*) collected on *H. nummularium*. The impression of a northern distribution of this species in Britain probably simply reflects a massive sampling bias (cf. Shaw, 1996 and unpublished; Menéndez *et al.*, in prep.).

All of the British *C. astrarches* seen to date have been reared from *Aricia* species, with the possible exception of one brood, doubtful because only a single male emerged, from *Cupido minimus* (Fuessly) collected in S. E. Scotland (VC 81; *A. Buckham*). While two broods reared from *Tomares ballus* (Fabricius) in Spain (Granada; *M. Ginés Muñoz*) and two broods from ? *Polyommatus thersites* (Cantener) (or possibly *Agrodiaetus* sp.) in Greece (N. Peloponnese; *T. Lafranchis*) that appear to be morphologically compatible with *C. astrarches* (and had similarly pale yellow cocoons) might suggest a wider host range, it is unsafe to determine them as this. In addition to the possibility that these specimens may belong to one or more additional biological species, the situation in mainland Europe is complicated by the presence of the extremely similar *Cotesia specularis* (Szépligeti), although that seems to be a slightly smaller species that generally produces larger broods and has white cocoons. *C. specularis* parasitises *Iolana iolas* (Ochsenheimer) and *Lampides boeticus*

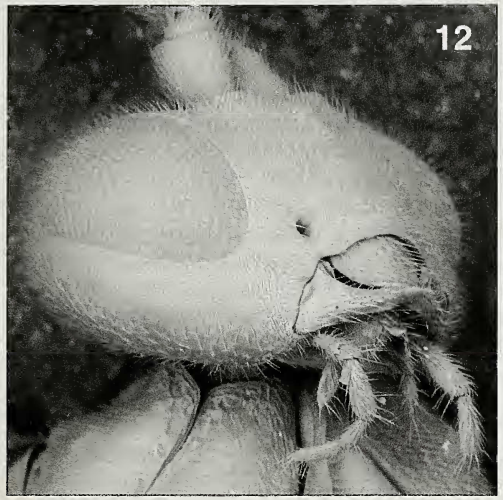


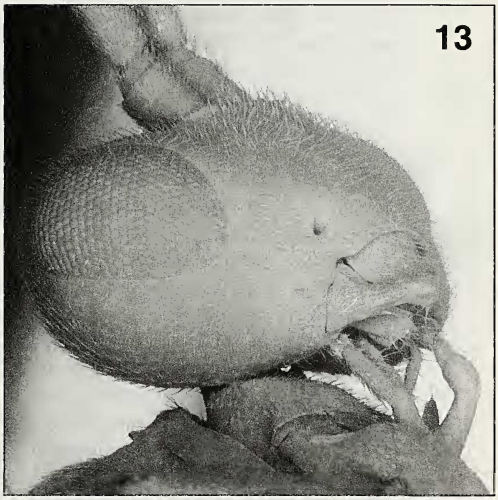


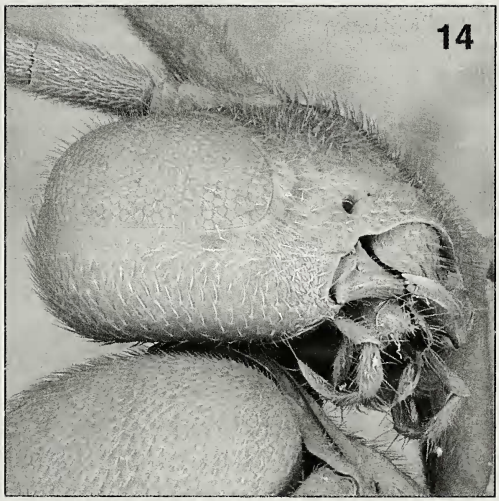




Figs 8–11. *Cotesia* species, head in facial view. 8. *Cotesia cuprea* (Lyle). 9, 10. *Cotesia tenebrosa* (Wesmael). 11. *Cotesia astrarches* (Marshall).







Figs 12–14. *Cotesia* species, head in ventro-anterio-lateral view. 12. *Cotesia cuprea* (Lyle). 13. *Cotesia tenebrosa* (Wesmael). 14. *Cotesia astrarches* (Marshall).

(Linnaeus) regularly in southern Europe, but it might have a wider host range and it is unclear whether its cocoon colour is constant.

Cotesia cuprea (Lyle)

This gregarious species was described as *Apanteles cupreus* by Lyle (1925) from four broods reared from *Lycaena phlaeas* (Linnaeus) in England, and has been redescribed in detail by Wilkinson (1945). It is a well-known and often common parasitoid of *L. phlaeas*, and a brief account of its causing repeated local extinctions

within a metapopulation of this host in England is given by Ford (1976). It probably parasitises most or all other *Lycaena* species in Europe: it is recorded by Nixon (1974) from *L. helle* (Denis & Schiffermüller), and from *L. dispar* (Haworth) below.

Wilkinson (1945) included single series supposedly reared from each of *Polyommatus icarus* (Rottemburg) and *Plebejus argus* (Linnaeus) in France in his redescription of *Apanteles cupreus*. While the former could not easily be reassessed, the latter brood (also recorded by Nixon (1974)) is in the BMNH and, having seen it, I concur with the identification of the specimens, though the host determination is less easy to accept. Two series of *Cotesia* reared on separate occasions from *Lampides boeticus* collected in France at St Jean de Luz, Basses-Pyrénées, that were recorded by Nixon (1974) as *A. cupreus* (and erroneously stated to be from two sites) are also in BMNH, and one specimen carries a Nixon determination label dated 1955 [there is no evidence that he re-examined the specimens in the course of his 1974 revision]. The specimens are in rather poor condition, but they are certainly not *C. cuprea* and are provisionally referred to *C. specularis*, which appears to be a regular parasitoid of this host in mainland southern Europe (see note under *C. astrarches*, above). There are several literature references to [*C. cuprea*] as a regular parasitoid of polyommatine Lycaenidae (e.g. Fiedler *et al.*, 1995) but, in the absence of clear confirmation of any, *C. cuprea* would appear, from the material in NMS, to be strongly specialised to Lycaenini and not to parasitise Polyommatini regularly.

In NMS there are ten typically coloured broods reared from *L. phlaeas*, nine collected in England (VCs 29, 30, 32, 33, 60; *R. L. E. Ford, P. Marren, R. Revels, D. Stokes, P. Tebbutt, I. P. Tuffs*) and one in France (Ariège; *D. Corke*). Two additional broods reared in autumn from this host collected in S. E. Scotland (VC 82; *P. Summers*) have the hind tibia almost completely reddish (rather than being strongly infuscate on about its apical two fifths, as is usual in both early summer and autumn broods), but they appear to belong to this species. There are also two broods reared on separate occasions from semi-captive stock of *Lycaena dispar* in England (VCs 21, 31; *P. W. Cribb, L. Martin*), and a brood from an unidentified *Lycaena* species from Finland (Åland; *S. van Nouhuys*). Brood sizes range from 2–28; most are in the upper teens.

Cotesia inducta (Papp)

New to Britain (cf. Revels, 2006). This species was described from non-reared material as *Apanteles inductus* from Hungary (Papp, 1973a) and later recorded also from Slovakia, Bulgaria and Turkey (Papp, 1986), though its hosts had remained unknown (cf. Papp, 1990). During the 1990s I received separate lots of reared specimens from Spain as follows: 2 ♀, 1 ♂, Nevada, Mijas, ex *Celastrina argiolus* (Linnaeus) [cocoons received with the specimens are on *Hedera* flower buds], em. 14.xi.1993 (*J. E. Pateman*); 1 ♀, Girona, El Cortalet, Aiguamolls de l'Emporda National Park, ex *C. argiolus* on *Rubus ulmifolius*, em. 17.vii.1996, (*C. Stefanescu*); and 1 ♀, Barcelona, Can Riera de Vilardell, ex *Glaucopsyche melanops* (Boisduval) on *Dorycnium hirsutum*, coll. 23.v.1999, em. v/vi.1999 (*C. Stefanescu*). This demonstrated that *C. inducta* is a solitary parasitoid of certain polyommatine Lycaenidae and suggested that it is widespread in Southern Europe. It was, nevertheless, surprising to receive British specimens for determination, first reared in 2004 by Richard Revels from *C. argiolus* in Bedfordshire (VC 30), where it has subsequently proved to be well spread and abundant from this host, both in the autumn generation on *Hedera* and in early summer on *Cornus* (cf. Revels, 2006). Further examples of *C. inducta* reared from *C. argiolus* in the British Isles have been

received from Bob Aldwell in 2006 reared from host larvae collected in the autumn of 2005 on *Hedera* in the south-eastern suburbs of Dublin (Ireland, VC H21), and from Peter Summers who collected parasitised larvae on *Hedera* at three sites in N. Yorkshire (VC 64) in the autumn of 2006. A single specimen received from Richard Revels reared from *Satyrium w-album* (Knoch) on *Ulmus glabra* in 2006 in Bedfordshire, as well as further material from Spain (Granada) reared in 2006 from both *Callophrys avis* Chapman (5) and *Tomares ballus* (Fabricius) (1) by Miguel Ginés Muñoz, added members of the tribe Eumaeini to its host spectrum and suggest that a substantial range of Lycaenidae are probably susceptible to parasitism by this species. More hosts in Britain are likely to become known: it is noteworthy that the host range known so far for *C. inducta* not only spans two tribes of Lycaenidae but also involves species feeding on low plants as well as shrubs. It would be interesting to know if it is capable of overwintering as a larva inside a diapausing host larva: if not, then this might limit its host range.

Revels (2006) includes a good colour photograph of a living female: when present, the orange scape is a particularly easy recognition feature, though British specimens from overwintering cocoons generally have the scape black or nearly so.

The ease with which *C. inducta* is now found as a parasitoid of *C. argiolus* in the British Isles and the lack of records prior to 2004 suggests that it is a fairly recent arrival, as *C. argiolus* has been regularly collected in the larval stage over the years, and the adults of *C. inducta* are strikingly and conspicuously unlike other British species of *Cotesia*. Papp (1987) states that the N. American species *Cotesia cyaniridis* (Riley), which was described from "*Cyaniris pseudargiolus*" (now regarded as a subspecies of *C. argiolus*), is "very similar" to *C. inducta*, which might suggest a transatlantic origin for the British (and presumably European) population. However, it is clear both from the original description of *Apanteles cyaniridis* Riley in Scudder (1889) and from Muesebeck's (1921) key to North American species of *Apanteles* (sensu lato), that *C. inducta* and *C. cyaniridis* are different species (indeed, according to an illustration in Fiedler *et al.* (1995), *C. cyaniridis* would appear to be a gregarious species). It is therefore presumed that the British population has resulted directly from the presence of *C. inducta* further south in Europe, and that it is a genuine member of the Palaearctic fauna.

Cotesia saltatoria (Balevski)

New to Britain. This species was described as *Apanteles saltatorius* from non-reared material collected in Bulgaria (Balevski, 1980), and it appears that it was J. Papp who was responsible for recognising it as a solitary parasitoid of polyommatine Lycaenidae (cf. Baumgarten & Fiedler, 1998, who record it from *Lysandra coridon* (Poda) and *Polyommatus icarus*). Reared material in NMS had remained unidentified for many years (e. g. recorded as *Cotesia* sp. in Shaw, 1996), but Papp's interpretation is followed here.

In NMS there are 14 British specimens reared from *P. icarus* collected from a wide spread of localities in England, and in S.E. Scotland (VCs 2, 11, 54, 58, 61, 83; *K. P. Bland, R. L. H. Dennis, J. L. Gregory, M. Oates, R. Menéndes Martínez*), eight specimens from *Aricia agestis* collected from both *Geranium molle* and *Erodium cicutarium* in central E. England (VCs 28, 53, 54; *R. Menéndes Martínez*), and four from *Aricia artaxerxes* collected on *Helianthemum nummularium* in S. E. Scotland and N. England (VCs 57, 69, 81, 82; *P. Summers*). Additionally there is a specimen from *Lysandra coridon* collected in Germany (Bavaria; *K. Fiedler*; don. J. Papp), three specimens from ?*P. icarus* collected in France (Var, Hautes-Alpes; *M. R. Shaw*),

two from *Polyommatus amandus* (Schneider) collected in Spain (Granada; *F. Gil-T, M. Ginés Muñoz*), and one from either *Aricia cramera* (Eschscholtz) or *A. agestis* also from Spain (Asturias; *M. Ginés Muñoz*).

A few of the individuals seen from *Aricia* are rather small, with somewhat more divergent eyes and consequently a relatively wide face. While they could be mistaken for specimens of *C. astrarches* with a brood size of one, others from *Aricia* are more typical of *C. saltatoria* and, even in the less typical examples, the anterior tentorial pit is only marginally closer to the mandible than the eye (cf. Figs 7 and 14) and the cocoon colour is bright. Therefore the variation seen is interpreted as the result of the relatively small size of the host species compared with *Polyommatus*.

Cotesia tenebrosa (Wesmael)

Although the type material of *Microgaster tenebrosus* Wesmael was not reared, there is no reason to doubt the current interpretation (Papp, 1986). The appearance of the name on the British check list (Fitton *et al.*, 1978, who list *Apanteles tenebrosus* as a synonym of *A. saltator* (Thunberg) [a non-British species] following Shenefelt, 1972) has, however, been at variance with this, as can be seen from the various non-lycaenid hosts listed for it by Shenefelt (1972). Papp (1986) showed that Nixon's (1974) interpretation of "*Apanteles arcticus* Thomson" was incorrect, but the situation is more complicated than Papp's (1986) conclusion that [*Cotesia*] *tenebrosa* is the correct name, and that *Apanteles astrarches* Marshall is probably a synonym, as the two species had been confounded in Nixon's (1974) concept (see under *C. astrarches*, above).

In NMS there are British broods of *C. tenebrosa* from *Lysandra bellargus* (Rottemburg) (ca seven broods, *J. A. Thomas*), *L.* ?*coridon* (*A. Harmer*) and *Plebejus argus* (*K. Murray*) from S. England (VC 9), and *Polyommatus icarus* from both N. Wales and central E. Scotland (VCs 48, 90; *M. J. Morgan*, *R. M. Lyszkowski*). In addition there are broods from *P. argus* collected in Finland (Åland; *V. Hyyryläinen*), *L. bellargus* in Andorra (*J. Dantart*), ?*P. icarus* (two broods) in France (Var; *M. R. Shaw*) and a total of five broods in Spain, from *Everes alcetas* (Hoffmannsegg) (Girona; *M. Ginés Muñoz*), *Lysandra arragonensis* (Gerhard) (Albacete; *M. Ginés Muñoz*), *L. albicans* (Herrich-Schäffer) (Granada; *M. Ginés Muñoz*), *L. coridon* (Lerida; *M. Ginés Muñoz*), and *Meleageria daphnis* (Denis & Schiffermüller) (Burgos; *M. Ginés Muñoz*).

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SHORT COMMUNICATIONS

Host plants of the Pale Mottled Willow *Paradrina clavipalpis* (Scop.) (Lepidoptera: Noctuidae). – With reference to Len Winokur's communication (2007) about finding a larva of *P. clavipalpis* within a spun leaf of goat willow *Salix caprea*, near Winchester (VC 12), one needs to decide whether it is a realistic food plant or not.

The Victorian, Edwardian and pre-war II lepidopterists, not having the advantages of ultra-violet light to find species, had to rely mainly on fieldwork. Scorer (1913) listed Poaceae (grasses), *Pisum* (pea) and seeds of *Plantago* (plantains). Allan (1949), a renowned fieldworker and author, listed *Plantago* spp., *Stellaria media* (chickweed), *Triticum vulgare* (wheat), on the grains and *Pisum sativum* (field pea), on the seeds. I have beaten and searched *Salix* at a number of sites in VC 11 and 12 (Dobson, 1989) where *P. clavipalpis* imagines have occurred at light, but never found the larvae on bushes or trees. I think it is evident that *P. clavipalpis* is not arboreal and that *Salix* is not its food plant and that it is simply a 'tourist' i.e. a non-predatory species that has no lasting association with the plant, but may be attracted for shelter, sun-basking or sexual display (Moran & Southwood, 1982).

I have witnessed, though rarely, other species exhibiting apparently unusual behaviour. One example was of the copper underwing *Amphipyra pyramidea* (L.) an arboreal species; I found a larva feeding on prostrate *Cotoneaster horizontalis* in a garden far removed from shrubs and trees at Sparsholt College (VC 11). The most puzzling host association occurred in April 1964, when I collected a disused song thrush's nest, which was 1 m up in a thick hedge at Cullompton (VC 3). In school, the children in my class carefully dismantled the nest to discover its composition. To our surprise there was a noctuid pupa within the base. I retained the pupa and on 24.v.1964 an adult clouded-bordered brindle *Apamea crenata* (Hufn.) emerged. This species, like *P. clavipalpis* is also a ground level feeding species, firstly on the flowers and immature seeds of Poaceae and later on the foliage; the pupa is in a loose cell spun amongst the roots of grasses (Emmet & Heath, 1983). Perhaps the reason for the larva spinning in the bird's nest was that its composition appeared like a tangle of roots. A clue for the *clavipalpis* larva's behaviour might be wood; it has been stated 'the pupa is in a tough cocoon of silk and other available material such as abraded wood and vegetable debris (ibid. p. 281). Was the larva attracted to the base of *Salix* by its woody stem? Why did both individual larvae climb up from ground level? Perhaps both were escaping adverse conditions on the ground.

I have experienced larvae of *P. clavipalpis* feeding well above the ground, because of human activity. On 5.i.1990 I answered a request for help by visiting Mr. & Mrs. Frith's cottage in Chestnut Avenue, Eastleigh (VC 11). They were being inundated by numerous larvae dropping from the thatch and falling down the chimneys. The cottage had been re-thatched the previous year with wheat reed on which, I presumed, many ova of the culprit, *P. clavipalpis*, had been laid. Barry Goater (1974) stated that, 'it was frequent in towns . . . and throughout the agricultural belt, where the larvae could be a minor pest in grain stacks and in growing wheat at harvest (CHD); the larva probably also feeds on wild grasses in chalk pasture.' C.H. Dixon lived at Northbridge Farm, Micheldever just under seven kilometres from where Winokur's larva was found. Changes in agricultural practices have removed this species from wheat and pea crops grown there and elsewhere.

I do agree with Len Winokur that *S. caprea* is a popular food plant for Lepidoptera. In an unpublished paper (1984) produced for the local Wild Life Trust, I compiled a list of food plants of Lepidoptera found in North Hampshire (VC 12) and the number of larval species per plant to show the relative importance of certain

plants to Lepidoptera, as a guide for conservation. The compilation was based on Lepidoptera species listed in Goater (1974), but excluding species with fewer than five specimens recorded and non-breeding migrant species. Food plants were listed from my experience and the literature: Scorer (1913), Stokoe (1948), Allan (1949), Emmet (1988) and Emmet and Heath (1979 & 1983). Top of the list for host trees were *S. caprea* (goat willow) and *Quercus* spp. (deciduous oaks), with 180 species each, followed by *Betula* spp. (birch) 175, and *Crataegus* spp. (hawthorns) 150. – A.H. DOBSON, 282 Britten Road, Basingstoke RG22 4HR.

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***Holcostethus vernalis* (Wolff) (Hem.: Pentatomidae) and *Bathysolen nubilis* (Fallén) (Hem.: Coreidae) in Hampshire**. – On 29 May 2007, I swept an adult male *H.vernalis* from a rough grassy glade in an abandoned orchard in Lock's Heath, South Hampshire (VC11) (SU5006). This appears to be the first record of this species in Hampshire (Bernard Nau, *pers. comm.*), and my second coming after another single male from the former Ore Power Station, Hastings, East Sussex (TQ8210) on 22 September 2003.

On 4 June 2007, I visited part of the old Royal Aircraft Establishment at Farnborough, North Hampshire (VC12) (SU8654), where a large area of black medick *Medicago lupulina* had developed on foundations of a building demolished in 2002. Having found *B. nubilus* in similar places in Essex and Kent in recent years, I was unsurprised to find adults under the first rosette examined. These appear to be the first seen in Hampshire, and a westerly extension to its known range, lying some 35km from Surbiton, where I found it new for Surrey in 1998. JONTY DENTON, 29 Yarnhams Close, Four Marks, Hants, GU34 5DH.